The Value of Control and the Costs of Illiquidity

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Agenda and motivation

- Valuation of controlling blocks.
- When a controlling block holder and dispersed shareholders coexist then:
  - Trade-off between **private** benefits (tunneling, perqs) and costs (effort, marketability) of control
  - Trade-off between **shared** benefits (incentive alignment, monitoring management) and costs ("illiquidity spillovers") of control
- This paper is an attempt at estimating:
  - **marketability discount** of controlling stakes and **illiquidity discount**, accounting for private benefits and shared benefits
  - identify the determinants of illiquidity in the market
- Why? Ownership *is* concentrated (Holderness 09, Dlugosz et al. 06).

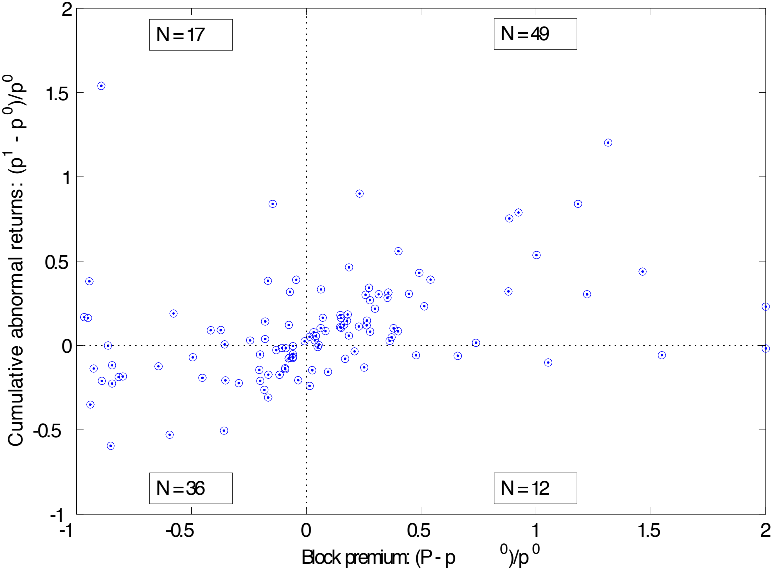
Approach to estimating marketability discount

1. Challenge:
    1. illiquidity introduces potential non-lineatities in pricing
    2. illiquidity constrains the empirical strategy
    3. estimating discounts requires knowledge of unobservables
2. Develop an estimable search-and-bargaining model of majority block trades
    1. Indentification of liquidity shocks intensity
    2. Identification of fire sale value
3. Data set: controlling block trades with share values from blockholder and dispersed shareholders
4. Structural estimation $\Rightarrow$ counterfactual analysis

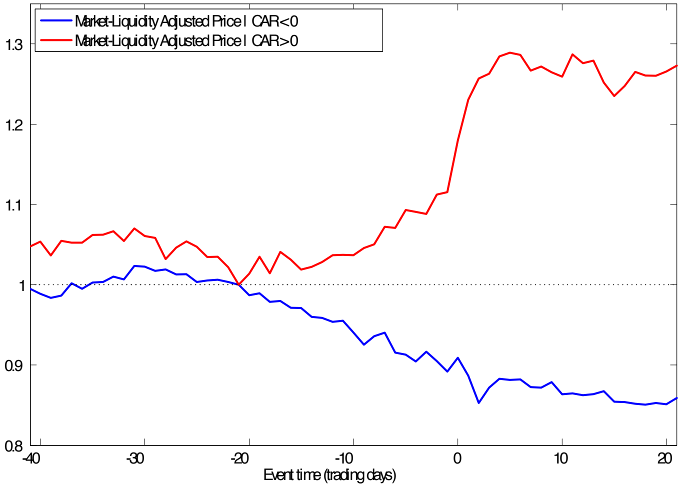
Literature

- Value of control: Masulis et al 09, Kalay et al 11, Albuquerque and Schroth 10
- Search models of OTC markets: Duffie et al 05, 07, Feldhutter 10
- Legal practice: Mandelbaum v. IRS (US Tax Court Case 1995-255):
  - **30% marketability discount** applied to shares of Big M
  - value based on prices of restricted and nrestricted shares: size of block?; control changes?
- Concentrated ownership and illiquidity: Demsetz 68, Holmstrom and Tirole 93, Bolton and von Thadden 98, Maug 98
- Illiquidity spillover: Vayanos and Wang 07, Weill 08, Amihud et al 97, Chordia et al 05, Aragon and Strahan 09
- Illiquidity on **non-controlling stakes**: Amihud and Mandelson 86, Pástor and Stambaugh 03, Acharya and Pedersen 05

Scatter plot of block premium and returns



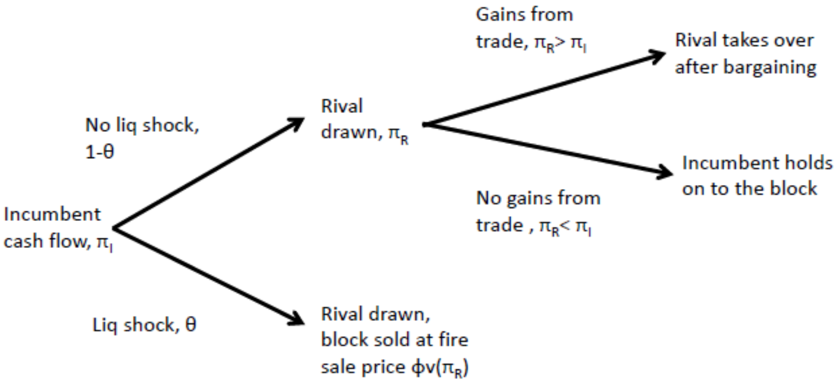
Share price path



Model: elements

- Discrete time, infinite horizon, with discount factor, δ.
- Incumbent, controlling shareholder, I
  - owns $\alpha > 0.5$, $1-\alpha$ is dispersed
  - current cash flow, π_I
  - private benefits B
  - block value $v(\pi_i)$, share price $p(\pi_i)$
  - I's Nash bargaining power is ψ
- **Search frictions; every period**:
  - with probability η, a rival R, arrives with current cash flow $\pi_R \sim F(\pi)$
  - I gets a liquidity shock with probability θ
  - upon liquidity shock get fire sale price, $\phi v(\pi_R)$

The block holder's problem



Blockholder's value

- The current per share value of the block satisfies

$$v(\pi_I) = \pi_I + \delta\left[(1-\theta)\,\tilde{v}(\pi_I) + \theta L_v\right],$$

where

$$\begin{aligned}
\tilde{v}(\pi_I) + B &= \eta \int_{\pi_R} \max\left\{ \underbrace{b(\pi_I, \pi_R)}_{sell}, \underbrace{v(\pi_I) + B}_{hold} \right\} dF(\pi_R) \\
&\quad + (1-\eta)\left(v(\pi_I) + B\right) \\
L_v &= \phi \int_{\pi_R} v(\pi_R)\, dF(\pi_R),
\end{aligned}$$

$\Rightarrow$ Blockholders exchange the **option** to sell in the future.

Nash bargaining and the trading rule

- Absent a liquidity shock, the block price results from Nash bargaining:

$$b(\pi_I, \pi_R) = \begin{cases} 0 & \text{if } \pi_R \le \pi_I \\ v(\pi_I) + B + \psi[v(\pi_R) - v(\pi_I)] & \text{if } \pi_R > \pi_I \end{cases},$$

- Trading rule only depends on cash flow values, π
- Value of option to sell depends on I's bargaining power, ψ

$$\tilde{v}(\pi_I) + B = v(\pi_I) + B + \psi\eta \int_{\pi_R} \max\{v(\pi_R) - v(\pi_I), 0\}\, dF(\pi_R)$$

Dispersed shareholders' value

- The current stock price must satisfy

$$p(\pi_I) = \pi_I + \delta\left[(1-\theta)\,\tilde{p}(\pi_I) + \theta L_p\right],$$

where

$$\begin{aligned}
\tilde{p}(\pi_I) &= p(\pi_I) + \eta \int_{\pi_R} \max\Bigg\{\underbrace{p(\pi_R) - p(\pi_I)}_{I \text{ sells}}, \underbrace{0}_{I \text{ holds}}\Bigg\}\, dF(\pi_R), \\
L_p &= \int_{\pi_R} p(\pi_R)\, dF(\pi_R).
\end{aligned}$$

- They inherit the block holder's option to sell
- Dispersed shareholders take as given (efficient) trading rule
- Their value does not depend on bargaining power ψ

Prices

- The observed block premium is

$$BP\left(\pi_I, \pi_R\right) = \begin{cases} \frac{\phi v(\pi_R)}{p(\pi_I)} - 1 & \text{if liquidity shock,} \\ \frac{b(\pi_I, \pi_R)}{p(\pi_I)} - 1 & \text{if no liquidity shock.} \end{cases}$$

- The observed cumulative returns are

$$CAR\left(\pi_R, \pi_I\right) \equiv \frac{p\left(\pi_R\right)}{p\left(\pi_I\right)} - 1.$$

- The econometrician's problem:
  - to recover the model's parameters knowing *BP* and *CAR*

Identification

- $\phi : p(\pi)$ and CAR are independent of ϕ, but BP isn't,
  - **conditional** on a liquidity shock, the variation in BP that is orthogonal to the variation in CAR is due to ϕ.

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  - **conditional** on a liquidity shock, the variation in BP that is orthogonal to the variation in CAR is due to ϕ.
- θ :
  - $CAR < 0$ signals liquidity shock
  - **absent** a liquidity shock, $BP/\psi - CAR$ is approximately equal to

$$\frac{v(\pi_R, \theta)}{v(\pi_I, \theta)} - \frac{p(\pi_R, \theta)}{p(\pi_I, \theta)} > 0,$$

which is strictly decreasing in θ.

Data

- US disclosed-value acquisitions in Thomson One Banker 1990-2010:
  - block size is between 35% and 90%,
  - Exclude recapitalizations, repurchases, carve-outs, bankruptcies,
  - must be matched to CRSP daily prices between $t-51$ and $t+20$ trading days,
  - must be matched to COMPUSTAT's last December's observation.

$\Rightarrow$ 114 deals

- Other data:
  - GDP growth, Fontaine-Garcia liquidity, market returns, returns vol and slope of yield curve
  - M&A volume in industry of target, block size, leverage and others

Empirical specification

- We derive the theoretical BP_i and CAR_i from a more general version: time-varying $\pi' \sim F(\pi'|\pi)$.
- For deal $i = \{1, 2, ..., N\}$, we parameterize ϕ_i and θ_i as

$$\begin{aligned}
\theta(\mathbf{z}_i, \boldsymbol{\beta}) &= \frac{\exp(\mathbf{z}_i' \boldsymbol{\beta})}{1 + \exp(\mathbf{z}_i' \boldsymbol{\beta})}, \\
\phi(\mathbf{x}_i, \gamma) &= \frac{\exp(\mathbf{x}_i' \gamma)}{1 + \exp(\mathbf{x}_i' \gamma)}.
\end{aligned}$$

- Choose $\boldsymbol{\beta}, \gamma, \eta, \psi, B$ to match the moments of the simulated joint distribution of BP and CAR to the data, minimizing

$$[\mathbf{m}(\mathbf{BP}, \mathbf{CAR}, \mathbf{z}, \mathbf{x}; \boldsymbol{\beta}, \gamma, \eta, \psi, B) - \mathbf{M}] \times W \times [\mathbf{m}(.) - \mathbf{M}].$$

Moment conditions

- First order moments

$$E\left(BP \times \mathbf{z}\right), E(CAR \times \mathbf{z}), E\left(BP \times \mathbf{x}\right), E(CAR \times \mathbf{x});$$

- Second order moments

$$E(BP^2), E(CAR^2), E(BP \times CAR);$$

- Conditional moments

$$\begin{aligned} E((BP/\psi - CAR) \times \mathbf{x}|CAR &> 0), E[(BP/\psi - CAR)^2|CAR > 0], \\ E(BP \times \mathbf{z}|CAR &< 0), E(BP^2|CAR < 0); \end{aligned}$$

- Third order moments

$$E(BP^3), (CAR^3).$$

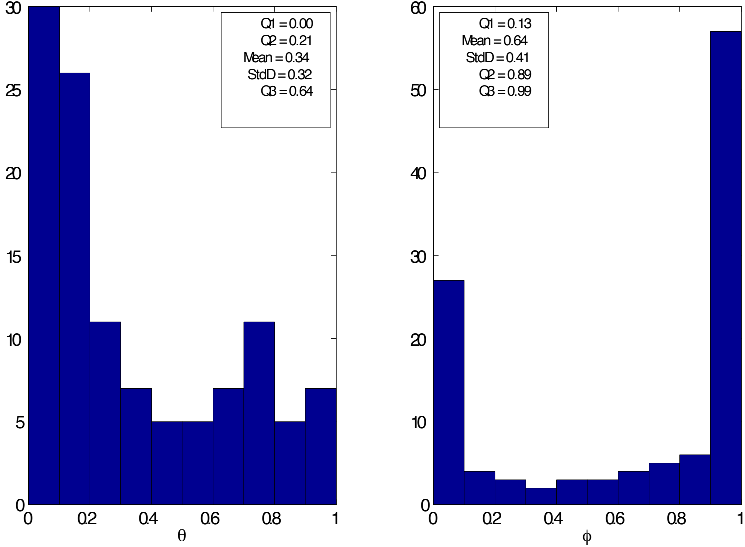
Parameter estimates: full specification

	(1)	
η	1.000	(0.952)
B	0.119***	(0.005)
ψ	0.540	(0.529)
Determinants of θ	$\Delta\theta/\Delta x$	
GDP growth	0.021	(0.013)
Market return	0.325***	(0.019)
Market volatility	0.290**	(0.128)
Fontaine-Garcia	0.023**	(0.009)
Yield curve slope	0.153***	(0.006)
Determinants of ϕ	$\Delta\phi/\Delta z$	
Block-to-industry size	−0.003	(0.017)
Industry's M&A volume	0.011**	(0.005)
Target minus industry leverage	−0.264	(0.206)
Industry specificity	−0.017	(0.013)
Industry market-to-book	−0.124***	(0.015)
Target volatility	−0.121***	(0.008)

Parameter estimates: full specification

	(1)		(2)	
η	1.000	(0.952)	1.000	(0.801)
B	0.119***	(0.005)	0.111***	(0.007)
ψ	0.540	(0.529)	0.406**	(0.156)
Determinants of θ	$\Delta\theta/\Delta x$		$\Delta\theta/\Delta x$	
GDP growth	0.021	(0.013)	−0.077	(0.105)
Market return	0.325***	(0.019)	−0.186***	(0.017)
Market volatility	0.290**	(0.128)	0.137***	(0.045)
Fontaine-Garcia	0.023**	(0.009)	0.147***	(0.047)
Yield curve slope	0.153***	(0.006)	0.079*	(0.046)
× GDP growth			0.262**	(0.118)
× Market Return			0.121**	(0.054)
Determinants of ϕ	$\Delta\phi/\Delta z$		$\Delta\phi/\Delta z$	
Block-to-industry size	−0.003	(0.017)	0.095***	(0.021)
Industry's M&A volume	0.011**	(0.005)	−0.099***	(0.015)
Target minus industry leverage	−0.264	(0.206)	−0.235***	(0.052)
Industry specificity	−0.017	(0.013)	−0.158***	(0.052)
Industry market-to-book	−0.124***	(0.015)	−0.112***	(0.019)
Target volatility	−0.121***	(0.008)	0.058***	(0.011)

Estimated θ and ϕ



In-sample predictions

	(1)			(2)		
	Mean	St D	Median	Mean	St D	Median
θ	0.374	0.32	0.267	0.342	0.315	0.205
ϕ	0.631	0.41	0.891	0.644	0.414	0.888
BP						
Actual	0.068	0.588	0.035	0.068	0.588	0.035
Predicted	0.013	0.552	0.122	0.058	0.561	0.146
CAR						
Actual	0.096	0.319	0.050	0.096	0.319	0.050
Predicted	0.002	0.016	0.000	0.002	0.016	0.000

Using the model

Having estimated the model's parameters, we compute:

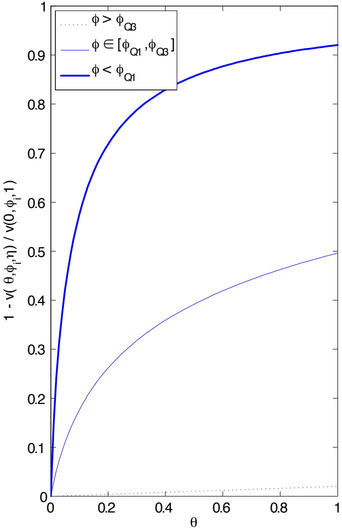
- The *marketability discount* is

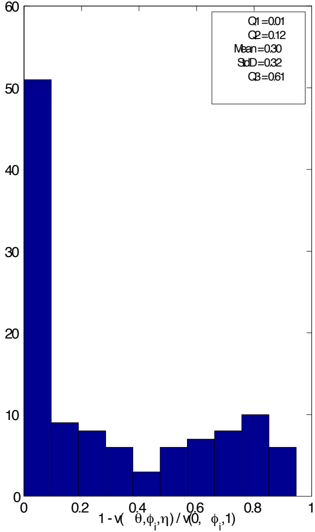
$$d^{M} = 1 - \frac{v\left(\theta, \phi, \eta, .\right)}{v\left(0, \phi, 1, .\right)}$$

- The *illiquidity-spillover discount* is

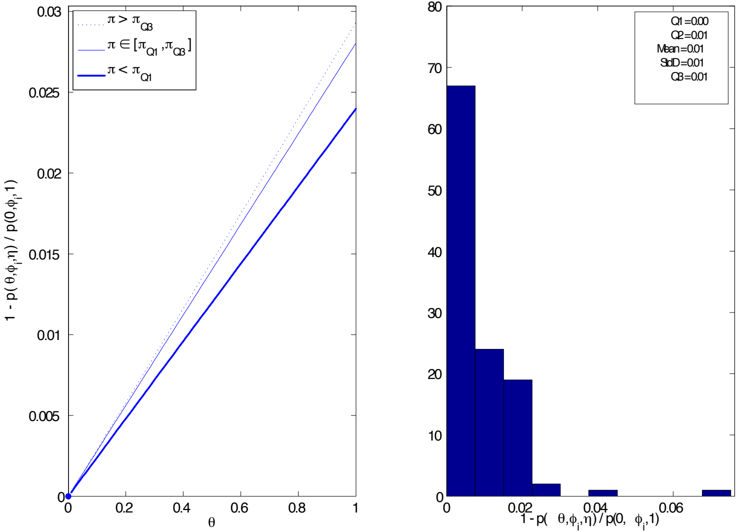
$$d^{IS} = 1 - \frac{p\left(\theta, \eta, .\right)}{p\left(0, 1, .\right)}$$

The marketability discount function





The illiquidity-spillover discount function



Interpreting discount estimates

Direction of potential biases from structural estimation of θ and ϕ:

- Suppose θ is a **pure** liquidity shock. Then ϕ is not a pure fire sale price
  $\Rightarrow$ model overestimates ϕ
- Suppose ϕ is a **pure** fire sale price. Then θ is not a pure liquidity shock
  $\Rightarrow$ model underestimates θ
- Discounts increase with θ and decrease with ϕ
  $\Rightarrow$ **discounts are underestimated.**

Linear effects

Determinant	Squared partial corr	p-value
Target minus industry leverage	0.31	0.00
Industry specificity	0.22	0.00
Ind market to book	0.19	0.00
Yield curve slope	0.08	0.01
Block-to-ind size	0.07	0.01

Mandelbaum et al v. Commissioner of Internal Revenue

In the Mandelbaum case, Big M had:

- Much lower leverage than the median leverage in the industry
- Lower industry asset specificity
- Slope of yield curve was lower than average
  $\Rightarrow$ Marketability discount predicted by model is about $7\% << 30\%$

Summary

- Adds to literatures on value of control and pricing of illiquid assets
- We propose a **search-and-bargaining** model to study the size and determinants of:
  - prob of liquidity shocks
  - fire sale price
- Structural estimation identifies them using variation in
  - proxies for aggregate liquidity,
  - target firm and industry characteristics linked to redeployability
- We find sizable
  - **marketability discount** with median 12%, and **illiquidity-spillover discount** with median 60 bp